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Bycatch of commercial groundfish species in the northern shrimp fisheries, 1980-1994

by

D.W. Kulka
Science Branch
Department of Fisheries and Oceans
P.O. Box 5667
St. John's, Newfoundland A1C 5X1
Canada

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Abstract

A fishery for shrimp (*Pandalus borealis* and *P. montagui*) has existed since the late 1970's. Shrimp grounds cover a large area from Lat. 70 N in Davis Strait, south along the Labrador Shelf to the Funk Island Deep (Fig. 1). These grounds overlap extensively with various groundfish species throughout the entire range. Concerns have frequently been expressed about the level of bycatch of groundfish species, particularly cod in the catches of shrimp. Because of the use of small mesh gear, this bycatch is often comprised of small fish. In all areas except Davis Strait, groundfish bycatch tended to decrease in recent years. The introduction of mandatory use of the grate in 1994 coupled with a decline in abundance of the stocks caused the reductions. Redfish still remains a significant problem in the north where the grate is not an effective excluder of small (mainly 10 to 20 cm) fish.

Résumé

La pêche de la crevette (*Pandalus borealis* et *P. montagui*) est pratiquée depuis la fin des années 70. L'aire de la crevette englobe une grande superficie, du 70° parallèle, dans le détroit de Davis, et le long du plateau continental du Labrador, jusqu'au trou de l'île Funk (fig. 1). Cette aire chevauche celles de plusieurs espèces de poisson de fond, ce qui suscite de fréquentes préoccupations au sujet des prises accessoires de poisson de fond, en particulier de la morue. Étant donné que le maillage des engins est relativement petit, les prises accessoires sont souvent composées de petits poissons. Dans toutes les zones, sauf le détroit de Davis, les prises accidentelles de poisson de fond ont tendance à diminuer depuis quelques années. Cette réduction est attribuable à l'utilisation de la grille, rendue obligatoire en 1994, ajoutée à la baisse de l'abondance des stocks. Le sébaste continue de poser un problème important dans le nord, où la grille n'exclut pas aussi efficacement les petits poissons (principalement ceux qui mesurent entre 10 et 20 cm).

Introduction

Two species of shrimp are fished commercially in Canadian waters, *Pandalus borealis* in six management areas off Newfoundland, Labrador and in the Davis Strait and *P. montagui,* from Ungava Bay and Hudson Strait. They are generally referred to as the northern shrimp fisheries. These lucrative Davis Strait and Labrador Shelf fisheries have existed since 1977 (Parsons, 1994) with landings increasing rapidly during the mid-1980's reaching 28,035 t in 1988, declining to 21,922 t in 1993 and increasing again to 25,611 t in 1994 (Fig. 1). Shrimp are also taken on the Flemish Cap, on St. Pierre Bank and off the west coast of Newfoundland in the Gulf of St. Lawrence but are not included in this study.

Shrimp grounds have increasingly expanded over the life of the fishery to cover an area of 250,000 km^2 from Lat. 70 N in Davis Strait in Ungava Bay, south along the Labrador Shelf to the Funk Island Deep (Fig. 2) These grounds overlap extensively with various groundfish species throughout the range. The gear used to capture shrimp is a modified otter trawl with small mesh gear. The result is the incidental capture of about 125 species other than shrimp including the commercially important species cod (Gadus morhua), redfish (Sebastes sp), turbot (Reinhardtius hippoglossoides) and American plaice (Hippoglossoides platessoides). Concerns have frequently been expressed about the level of bycatch of groundfish species, particularly cod in the catches of shrimp. Because of the use of small mesh gear, this bycatch is often comprised of small fish.

Bycatch species are of no commercial value to the shrimp industry and their presence, particularly small redfish makes it more difficult to process the shrimp. Thus, the shrimp industry prefers to avoid these bycatches. In an attempt to resolve this problem, an excluder, the Nordmore grate was introduced in Canadian waters in 1993 and used to a considerable extent by some shrimp vessels in that year. Based on the detailed records of catch collected by fishery observers since 1980, bycatch management areas were implemented in 1994 where use of the Nordmore grate was made mandatory in some areas where bycatch was observed to be high. In other areas, the policy was to deploy the grate if total groundfish bycatch exceeded 300 kg per day. The purpose of this paper is to quantify amounts of the major commercial species taken incidentally with the shrimp since 1980 and to examine the effect of the introduction of the Nordmore grate.

Methods

Fishery observers have recorded the weight of all species in the catches of northern shrimp since 1980. Method for estimating weight of bycatch of each species is outlined in Kulka and Firth (1987). Up to 1986, observers were deployed to a portion of the shrimp vessels as shown in Table 1. Mandatory use of fishery observers in the northern shrimp fishery since 1987, and a specific requirement of these observers to quantify all bycatch species for each fishing set has yielded a very detailed data set on bycatch levels. Not all sets were observed even after 1987 since only one observer was deployed per vessel and fishing for shrimp is a 24-hour operation. Also, due to logistic problems in deploying observers, not all shrimp fishing effort was covered even after 1987 and percent of observed sets is specified in Figure 2 (not all data are yet available for analysis for 1994 thus the relatively low percent observed in that year).

Catch of each species of bycatch was adjusted to the landings by applying a ratio of landings / observed catch of shrimp to the observed catch of each species. Where observed catch exceeded reported landings, observed figures were used. Bycatches were adjusted by shrimp fishing area by month.

Results

Table 1 and Figure 3 summarize shrimp and groundfish bycatch in Davis Strait, Hudson Strait and Ungava Bay for 1980 to 1994. The majority of bycatch in these areas in all years was redfish and most came from the northern portion of Davis Strait. From 1982 to 1992, amounts of redfish in the catches increased 18 times then declined by about 50% in 1993. Figure 4 shows that redfish as a proportion of shrimp fluctuated on an upward trend in about a 4-year cycle that may relate to recruitment pulses. Redfish bycatch peaked at over 25% of the weight of shrimp (2,209 t) in 1992. Turbot, the second most abundant bycatch in the area was only about 20% of the weight of redfish. Amounts tended to be greater in the later years. Amounts of cod and redfish were not significant. The Nordmore grate was not used in this area because it had little or no effect on reducing the bycatch of redfish. This is because the redfish were very small, mainly 10-20 cm and easily passed through the grid.

Table 2 and Figure 5 summarize shrimp and groundfish bycatch in NAFO Div. 2G and 2H. While the catches of shrimp rose from 643 t in 1983 to almost 9,499 t in 1989 and levelled off thereafter at more than 7,000 t, groundfish bycatch tended to stay relatively stable during that period. This was due in part to the declining cod bycatch. Figure 6 shows that the proportion of all four groundfish species as a percent of the weight of shrimp fell dramatically in 1985 perhaps reflecting a reduction of groundfish in the vicinity of the shrimp grounds. Proportions of redfish and turbot did increase slightly until 1991/1992 but did not approach the proportions observed before 1986. Bycatches were at their lowest in 1993 and 1994 because of the effect of the Nordmore grate coupled with the reduced abundances on the shrimp grounds.

Table 3 and Figure 7 summarize shrimp and groundfish bycatch in NAFO Div. 2J, 3K and 2L. Bycatches peaked in 1988 due mainly to cod. Proportions of groundfish were highest in the early years of the study (Fig. 8) then after 1988, the proportions levelled off until 1991 then dropped to very low levels. The exception was redfish that peaked in 1990. Bycatches were insignificant in 1993 and 1994 due to the effect of the Nordmore grate coupled with the reduced abundances on the shrimp grounds as in NAFO Div. 2G and 2H.

Discussion

In general, bycatch both in terms of weight and as a proportion of the shrimp catch declined in recent years and were insignificant in 1993 and 1994. The introduction of the grate coupled a decline in abundance of the stocks over the Labrador Shelf caused the low bycatches. The shrimp fisheries have not been a significant contributor to groundfish mortality in recent years in this area. However, redfish remains a significant problem to the north in Davis Strait where the grate is not an effective excluder of small (mainly 10 to 20 cm) fish.

Table 1 - Bycatch of turbot, redfish, cod and American plaice from the shrimp fisheries in Davis Strait, Ungava Bay and Huson Strait. All values are expressed in metric tonnes.

Davis Strait North

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	0.7	1.3	9.0	11.1	10.6	19.9	10.5	1.3	2.7	1.0	0.4	2.9	0.5	0.8	38.0	7.4
Plaice	27.2	28.9	38.0	29.6	9.9	15.5	0.0	7.1	13.5	4.7	2.7	11.0	2.8	15.1	25.0	15.4
Redfish	907.3	779.4	1,950.9	1,419.8	801.3	1,085.0	725.2	1,090.2	628.9	178.0	109.7	142.0	123.5	525.4	557.6	734.9
Turbot	179.9	166.6	262.8	320.8	158.2	171.8	139.3	139.4	56.2	35.8	43.8	77.2	22.1	56.0	23.6	123.6
Shrimp	4,766.0	5,501.0	7,493.0	6,788.0	6,175.8	7,235.0	5,895.2	6,108.2	3,107.1	3,079.2	2,178.9	5,413.0	2,333.0	5,284.0	3,620.1	4,998.5
Total	**5,881.1**	**6,477.2**	**9,753.7**	**8,569.3**	**7,155.8**	**8,527.2**	**6,770.2**	**7,346.2**	**3,808.4**	**3,298.7**	**2,335.5**	**5,646.1**	**2,481.9**	**5,881.3**	**4,264.3**	**5,879.8**

Davis Strait South

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	0.0	0.0	0.9	0.3	1.4	8.5	2.9									2.0
Plaice	0.5	0.2	0.0	1.3	1.5	6.1	3.2									1.8
Redfish	41.9	19.0	258.3	168.6	181.6	197.0	74.8									134.5
Turbot	9.2	3.7	40.0	42.0	27.6	95.9	66.7									40.7
Shrimp	475	106	1,291.0	1,105.4	1,613.0	3,040.3	2,827.4									1,494.0
Total	**526.6**	**128.9**	**1,590.2**	**1,317.6**	**1,825.1**	**3,347.8**	**2,976.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	780.7

Ungava Bay/Hudson Str.

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	0.0		0.0	0.1	0.0	0.1	0.2	0.1	0.0					0.0	0.0	0.1
Plaice	0.6		0.0	0.7	0.1	2.6	0.5	0.3	0.0					0.0	0.0	0.5
Redfish	0.2		0.2	3.0	0.1	1.9	4.1	4.1	0.2					0.1	0.0	1.4
Turbot	8.8		0.1	13.5	0.5	12.3	7.1	7.2	0.7					2.3	0.2	5.3
Shrimp	244.0		0.7	635.0	164.5	1,264.8	1,125.0	1,169.0	477.0					13.0	104.0	519.7
Total	**253.6**	**0.0**	**1.0**	**652.3**	**165.2**	**1,281.7**	**1,137.0**	**1,180.7**	**477.9**	**0.0**	**0.0**	**0.0**	**0.0**	**15.4**	**104.2**	351.3

Davis Strait/Ungava Bay (Shrimp Area 2 & 3)

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	0.7	1.3	9.9	11.5	12.0	28.5	13.6	1.4	2.7	1.0	0.4	2.9	0.5	0.8	38.0	8.3
Plaice	28.3	29.1	38.0	31.6	11.5	24.2	3.7	7.4	13.5	4.7	2.7	11.0	2.8	15.1	25.0	16.6
Redfish	949.4	798.4	2,209.4	1,591.4	983.0	1,283.9	804.1	1,094.3	629.1	178.0	109.7	142.0	123.5	525.5	557.6	798.6
Turbot	197.9	170.3	302.9	376.3	186.3	280.0	213.1	146.6	56.9	35.8	43.8	77.2	22.1	58.3	23.8	146.1
Shrimp	5,485.0	5,607.0	8,784.7	8,528.4	7,953.3	11,540.1	9,847.6	7,277.2	3,584.1	3,079.2	2,178.9	5,413.0	2,333.0	5,297.0	3,724.1	6,042.2
Total	**6,661.3**	**6,606.1**	**11,344.9**	**10,539.2**	**9,146.1**	**13,156.7**	**10,882.2**	**8,526.9**	**4,286.3**	**3,298.7**	**2,335.5**	**5,646.1**	**2,481.9**	**5,896.7**	**4,368.5**	7,011.8

Table 2 - Bycatch of turbot, redfish, cod and American plaice from the shrimp fisheries in NAFO Divs. 2G and 2H. All values are expressed in metric tonnes.

2G

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	0.5	0.9	4.4	3.4	5.2	14.2	0.8	0.0						0.1	0.2	3.4
Plaice	1.1	0.5	0.0	0.7	1.4	7.8	0.4	0.0						0.0	0.0	1.5
Redfish	45.9	100.0	214.5	117.6	137.1	132.1	68.7	0.1						0.4	0.0	65.1
Turbot	9.5	11.3	30.2	29.6	44.8	75.5	11.7	0.1						0.7	0.3	23.2
Shrimp	3,982.0	2,723.0	2,706.0	2,553.6	2,945.0	4,293.8	1,087.6	0.5						9.8	30.5	1,560.1
Total	**4,039.0**	**2,835.7**	**2,955.1**	**2,704.9**	**3,133.5**	**4,523.4**	**1,169.2**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**11.0**	**31.0**	**1,653.4**

Hopedale

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	0.6	7	29.7	70.3	11.6	16.6	30.4	16.5	93.0	200.0	25.4	33.3	66.0	137.4	137.9	69.9
Plaice	6.2	9.2	35.9	60.9	46.3	53.8	42.3	50.4	44.5	20.6	17.0	5.7	9.8	33.4	11.4	33.0
Redfish	49.2	57.1	138.7	226.8	139.0	134.4	197.1	143.3	87.9	211.0	26.2	13.7	112.0	246.7	84.1	135.2
Turbot	100.2	117.8	193.4	487.0	339.5	268.0	224.5	115.4	136.7	421.4	93.1	83.6	160.6	247.6	553.2	260.9
Shrimp	4199	4273	4,680.0	4,501.0	4,009.3	4,503.0	6,880.6	4,629.2	3,485.0	1,735.6	567.5	507.2	1,743.2	3,926.1	4,191.0	3,389.9
Total	**4,355.2**	**4,464.1**	**5,077.7**	**5,346.0**	**4,545.7**	**4,975.8**	**7,374.9**	**4,954.8**	**3,847.1**	**2,588.6**	**729.2**	**643.4**	**2,091.6**	**4,591.2**	**4,977.6**	**3,888.8**

2GH (Shrimp Area 4 & 5 {partial})

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	1.1	7.9	34.1	73.7	16.8	30.8	31.2	16.5	93.0	200.0	25.4	33.3	66.0	137.5	138.1	71.9
Plaice	7.3	9.7	35.9	61.6	47.7	61.6	42.7	50.4	44.5	20.6	17.0	5.7	9.8	33.4	11.4	33.9
Redfish	95.1	157.1	353.2	344.4	276.1	266.5	265.8	143.4	87.9	211.0	26.2	13.7	112.0	247.1	84.1	173.2
Turbot	109.7	129.1	223.6	516.6	384.3	343.5	236.2	115.5	136.7	421.4	93.1	83.6	160.6	248.3	553.5	274.4
Shrimp	8,181.0	6,996.0	7,386.0	7,054.6	6,954.3	8,796.8	7,968.2	4,629.7	3,485.0	1,735.6	567.5	507.2	1,743.2	3,935.9	4,221.5	4,300.0
Total	**8,394.2**	**7,299.8**	**8,032.8**	**8,050.9**	**7,679.2**	**9,499.2**	**8,544.1**	**4,955.5**	**3,847.1**	**2,588.6**	**729.2**	**643.4**	**2,091.6**	**4,602.2**	**5,008.6**	**4,853.3**

Table 3 - Bycatch of turbot, redfish, cod and American plaice from the shrimp fisheries in Nafo Divs. 2J, 3K and 3L. All values are expressed to the nearest metric tonne.

Cartwright Channel

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	9.6	2.8	7.6	6.4	14.7	26.2	1.3	4.6	72.8	0.4	1.1	0.0	5.9	18.9	31.7	13.6
Plaice	4.3	12.2	5.8	16.4	10.3	6.0	4.9	14.3	15.9	0.0	0.1	0.0	3.0	2.0	0.3	6.4
Redfish	9.6	2.8	5.3	7.3	9.7	6.2	0.4	5.8	7.0	0.1	1.1	0.0	3.7	2.6	1.1	4.2
Turbot	43.9	67.3	39.6	171.2	153.0	85.0	6.4	104.6	138.0	3.2	6.9	0.0	11.1	30.0	17.0	58.5
Shrimp	3,300.0	1,446.0	1,635.0	1,650.2	1,601.9	1,672.0	1,270.9	1,239.7	1,326.9	2.0	7.9	0.0	138.2	69.7	170.4	1,035.4
Total	**3,367.4**	**1,531.1**	**1,693.3**	**1,851.5**	**1,789.5**	**1,795.4**	**1,283.9**	**1,369.0**	**1,560.6**	**5.7**	**17.1**	**0.0**	**161.9**	**123.2**	**220.5**	**1,118.0**

Hawke Channel

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	8.7	40.9	124.4	383.7	24.0	103.5	1,218.4	215.5						47.6		240.7
Plaice	53.0	6.1	12.5	43.3	9.4	20.8	31.4	14.3						24.9		24.0
Redfish	14.5	16.9	21.6	8.5	3.8	3.4	101.3	14.3						1.6		20.7
Turbot	47.0	29.4	43.1	93.3	18.9	24.1	30.6	16.5						9.5		34.7
Shrimp	6,124.0	3,672.0	3,015.0	1,983.7	1,935.4	1,855.9	3,606.9	974.2						189.2		2,817.4
Total	**8,247.2**	**3,766.3**	**3,216.6**	**2,512.5**	**1,991.5**	**2,007.7**	**4,988.6**	**1,234.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**272.8**	**0.0**	**1,882.5**

St. Anthony E.

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	2.8	2.3	10.6	35.8	60.8	36.4	23.1									24.5
Plaice	0.5	5.4	2.9	12.7	35.3	51.6	42.6									21.6
Redfish	3.0	18.7	4.8	12.2	96.8	159.0	49.6									49.2
Turbot	4.4	19.5	6.3	25.1	84.1	77.3	24.6									34.5
Shrimp	689.0	2,565.0	491.0	977.9	1,162.4	1,336.0	1,265.4									1,241.0
Total	**699.7**	**2,610.9**	**515.6**	**1,063.7**	**1,439.3**	**1,660.3**	**1,405.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**639.7**

St. Anthony W.

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod		0.5	18.8	68.0	61.9	53.5	14.9	91.5								44.2
Plaice		0.6	10.6	30.6	29.0	15.8	16.6	18.0								17.3
Redfish		0.5	5.3	9.5	9.2	26.8	7.1	13.0								10.2
Turbot	0.2	3.9	27.6	85.6	80.1	39.5	26.7	35.1								37.3
Shrimp	13.0	213.0	1,294.0	1,828.7	1,672.3	1,393.2	777.5	165.7								919.7
Total	**13.2**	**218.5**	**1,356.3**	**2,022.4**	**1,852.6**	**1,528.8**	**842.8**	**323.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**543.9**

Table 3 (cont.) - Bycatch of turbot, redfish, cod and American plaice from the shrimp fisheries in Nafo Divs. 2J, 3K and 3L. All values are expressed to the nearest metric tonne.

Funk Island Deep

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	0.9	0.0	70.9	64.1	227.1	280.7	257.9									128.8
Plaice	0.5	3.1	18.0	26.0	48.7	85.5	132.5									44.9
Redfish	2.7	6.4	17.3	20.8	269.5	178.2	192.1									98.1
Turbot	2.7	14.0	17.6	18.1	267.3	164.5	242.7									103.8
Shrimp	878.0	1,440.0	1,150.0	995.4	1,129.5	2,239.6	2,052.6									1,412.2
Total	**884.8**	**1,463.6**	**1,273.8**	**1,124.4**	**1,942.1**	**2,948.5**	**2,877.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**834.3**

2J3KL (Shrimp Area 5 {partial} & 6)

	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	Average
Cod	22.0	46.5	232.3	558.0	388.4	500.3	1,515.6	311.6	72.8	0.4	1.1		5.9	66.5	31.7	268.1
Plaice	58.3	27.4	49.8	129.0	132.7	179.7	228.0	46.5	15.9	0.0	0.1		3.0	26.9	0.3	64.1
Redfish	29.8	45.3	54.3	58.3	389.0	373.6	350.4	33.1	7.0	0.1	1.1		3.7	4.2	1.1	96.5
Turbot	98.2	134.1	134.2	393.3	603.3	390.5	331.0	156.2	138.0	3.2	6.9		11.1	39.5	17.0	175.5
Shrimp	13,204.0	9,336.0	7,585.0	7,435.9	7,501.5	8,496.7	8,973.3	2,379.6	1,326.9	2.0	7.9	0.0	138.2	258.9	170.4	4,454.4
Total	**13,412.3**	**9,589.3**	**8,055.6**	**8,574.5**	**9,015.0**	**9,940.7**	**11,398.3**	**2,927.0**	**1,560.6**	**5.7**	**17.1**	**0.0**	**161.9**	**396.0**	**220.5**	**5,018.3**

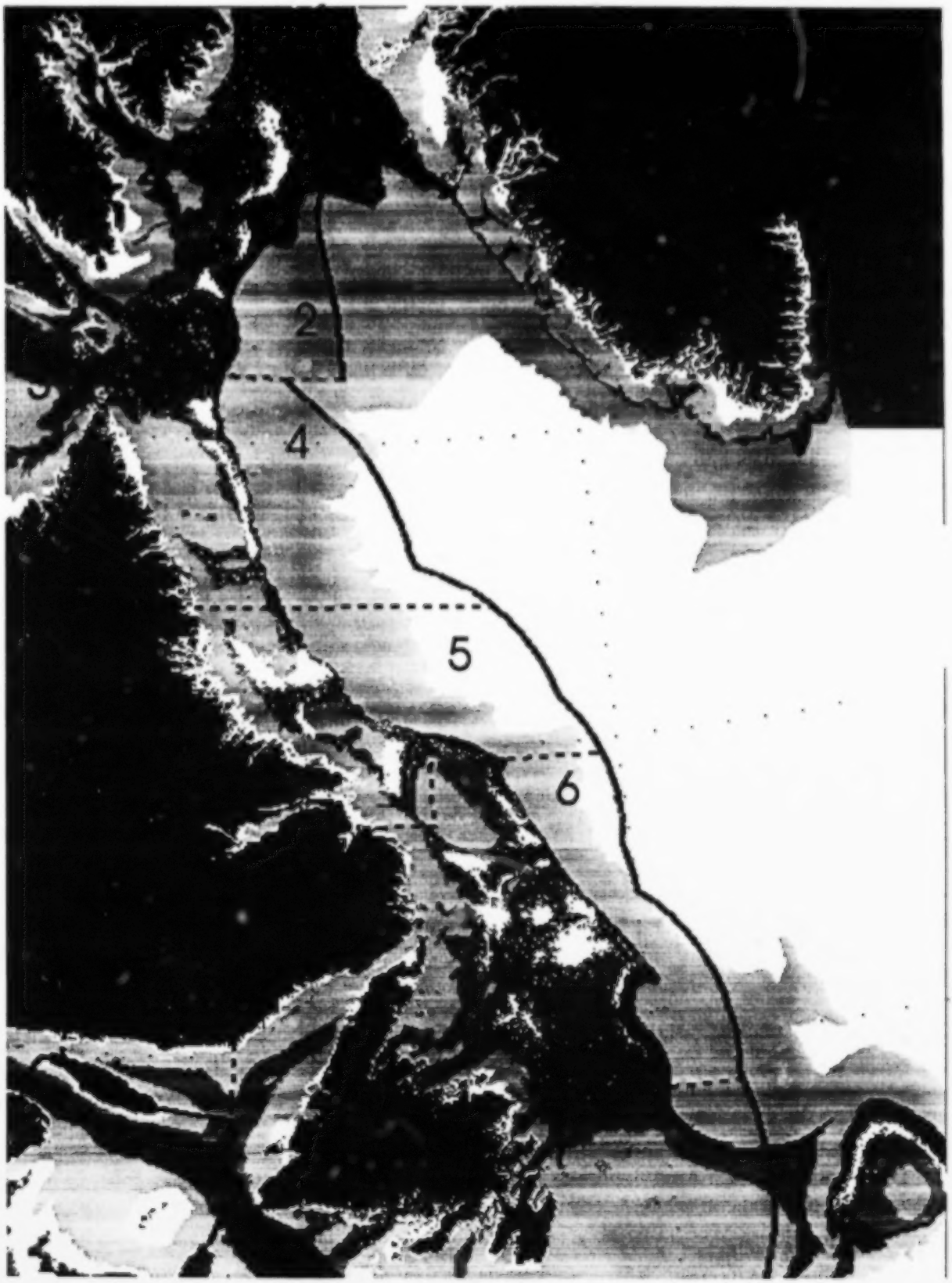
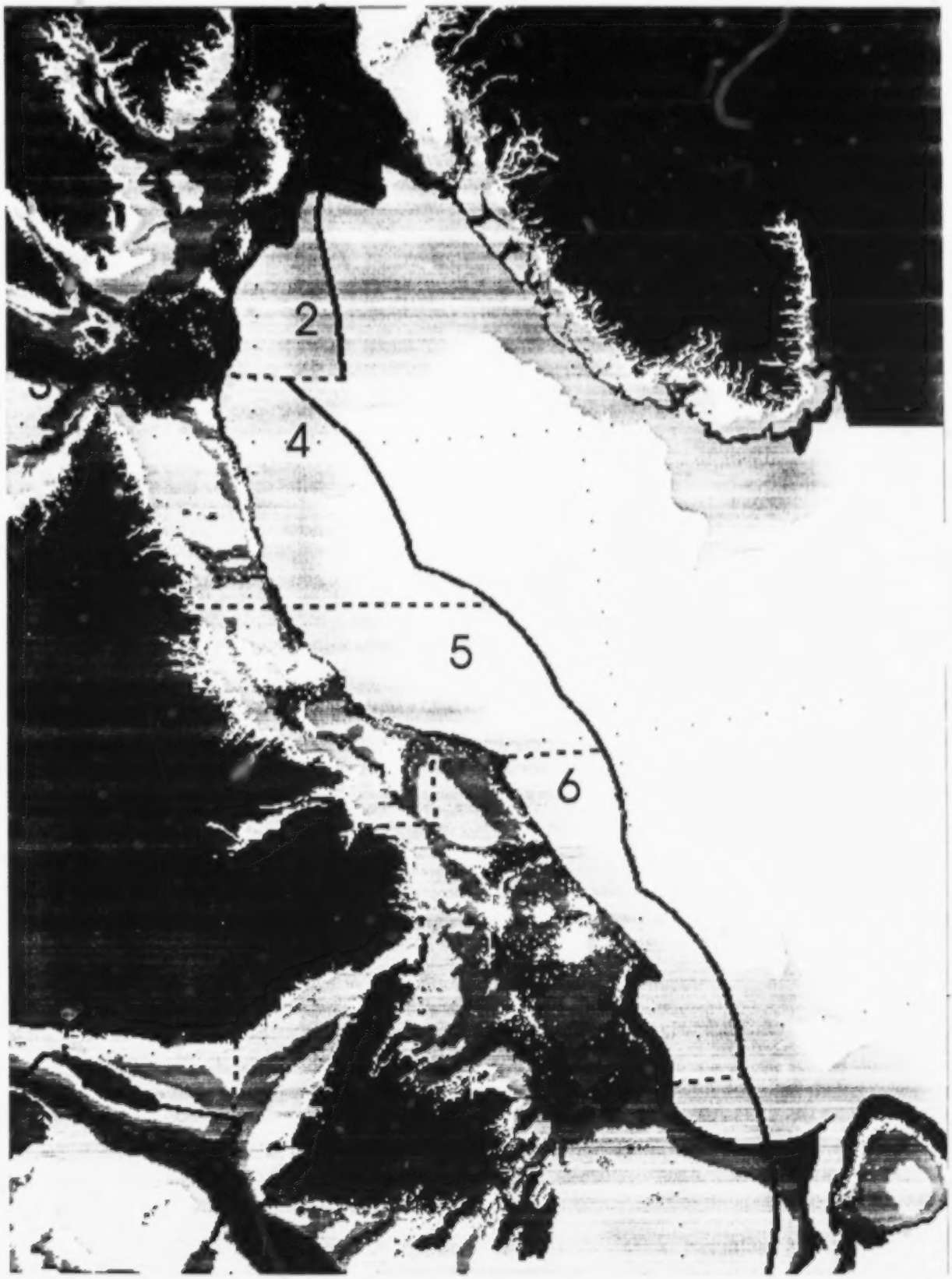


Figure 1 - Location of shrimp grounds depicted by white patches. Areas shown are shrimp Statistical Areas.



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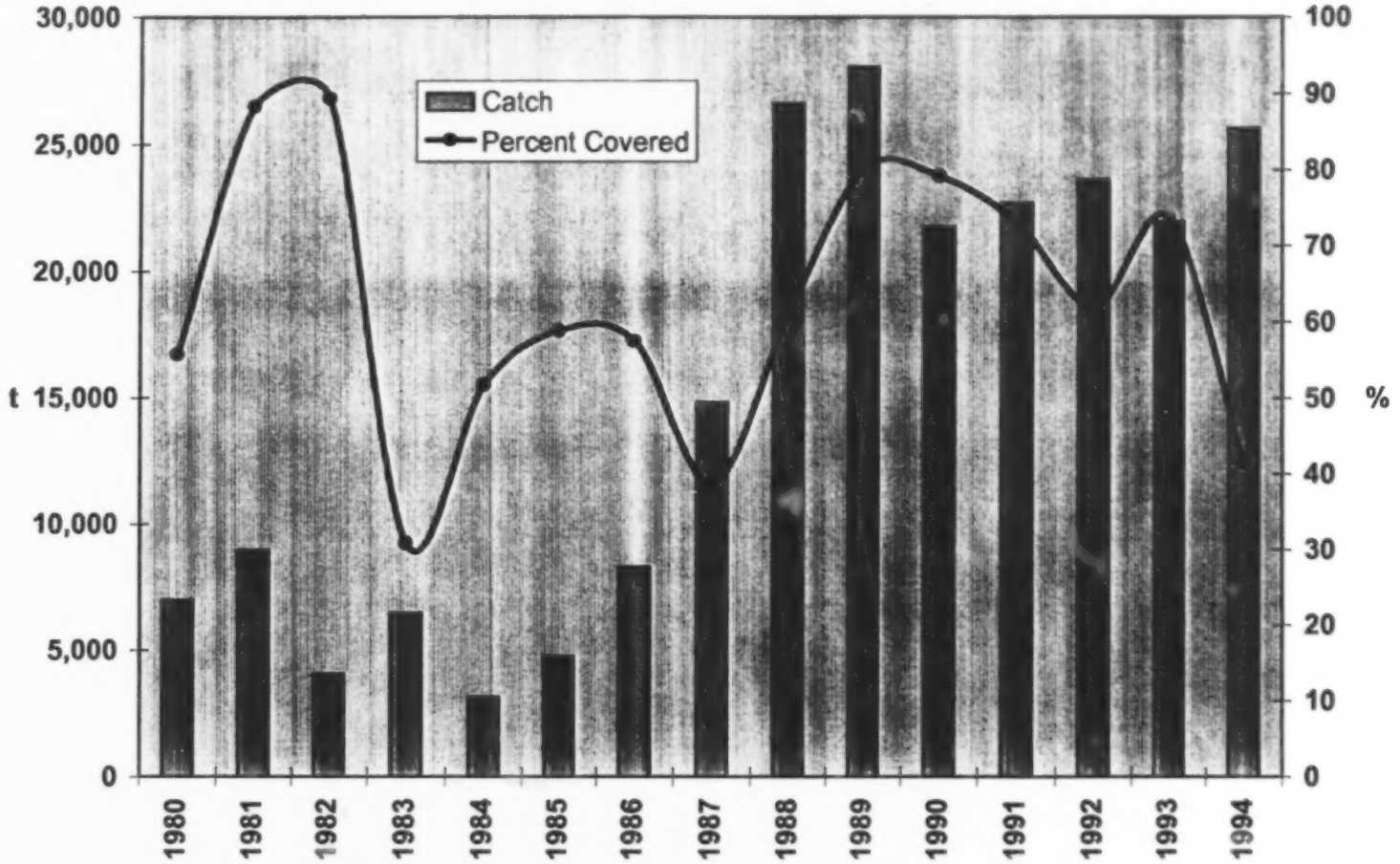

Figure 2 - Catch of shrimp and percent of sets where estimates of weight of bycatch was done in the Davis Strait and Labrador Shelf shrimp fiseries for 1980 to 1994.

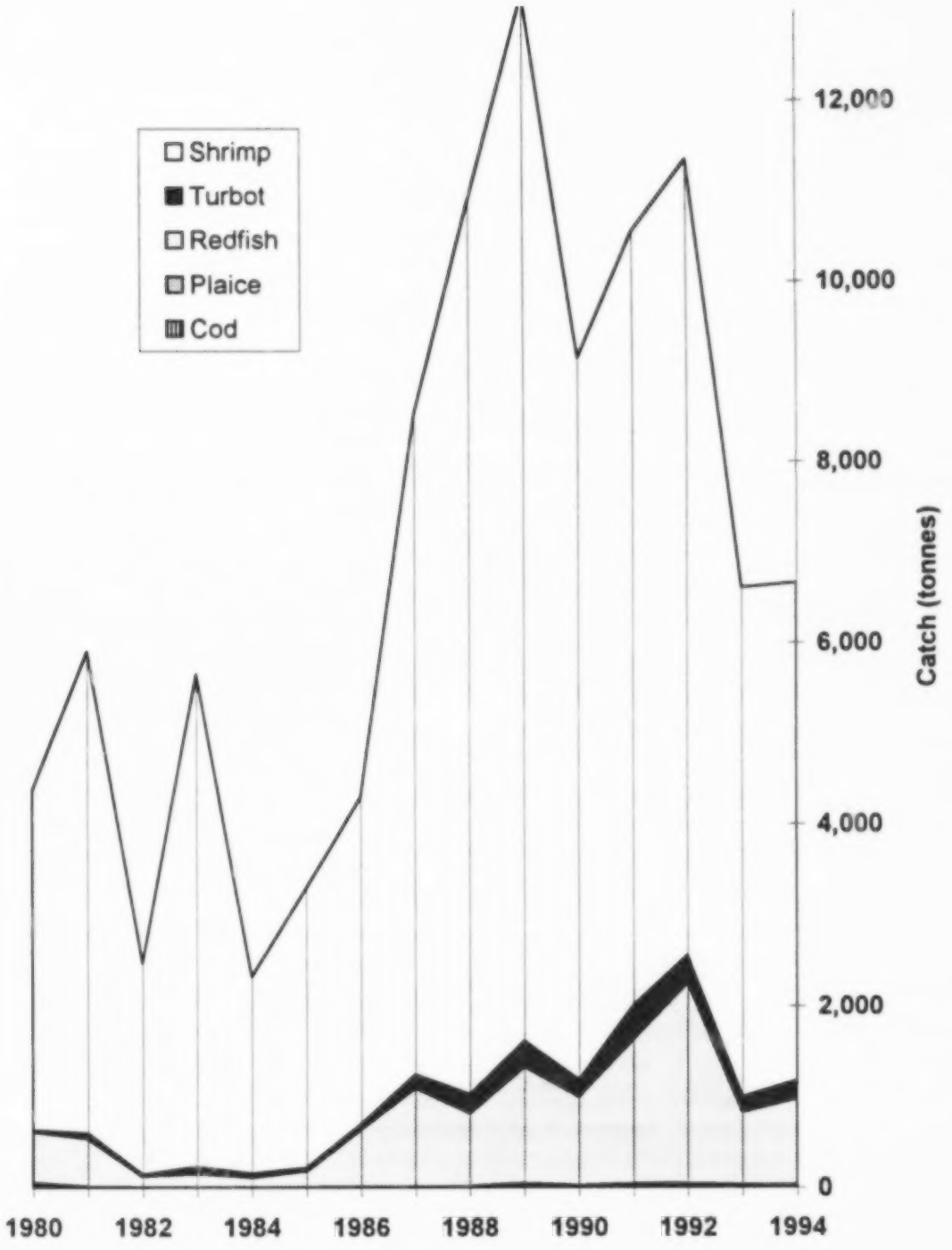

Figure 3 - Catch composition from the Davis Strait, Hudson starait and Ungava Bay shrimp fisheries. Only the major commercial bycatch are illustrated.

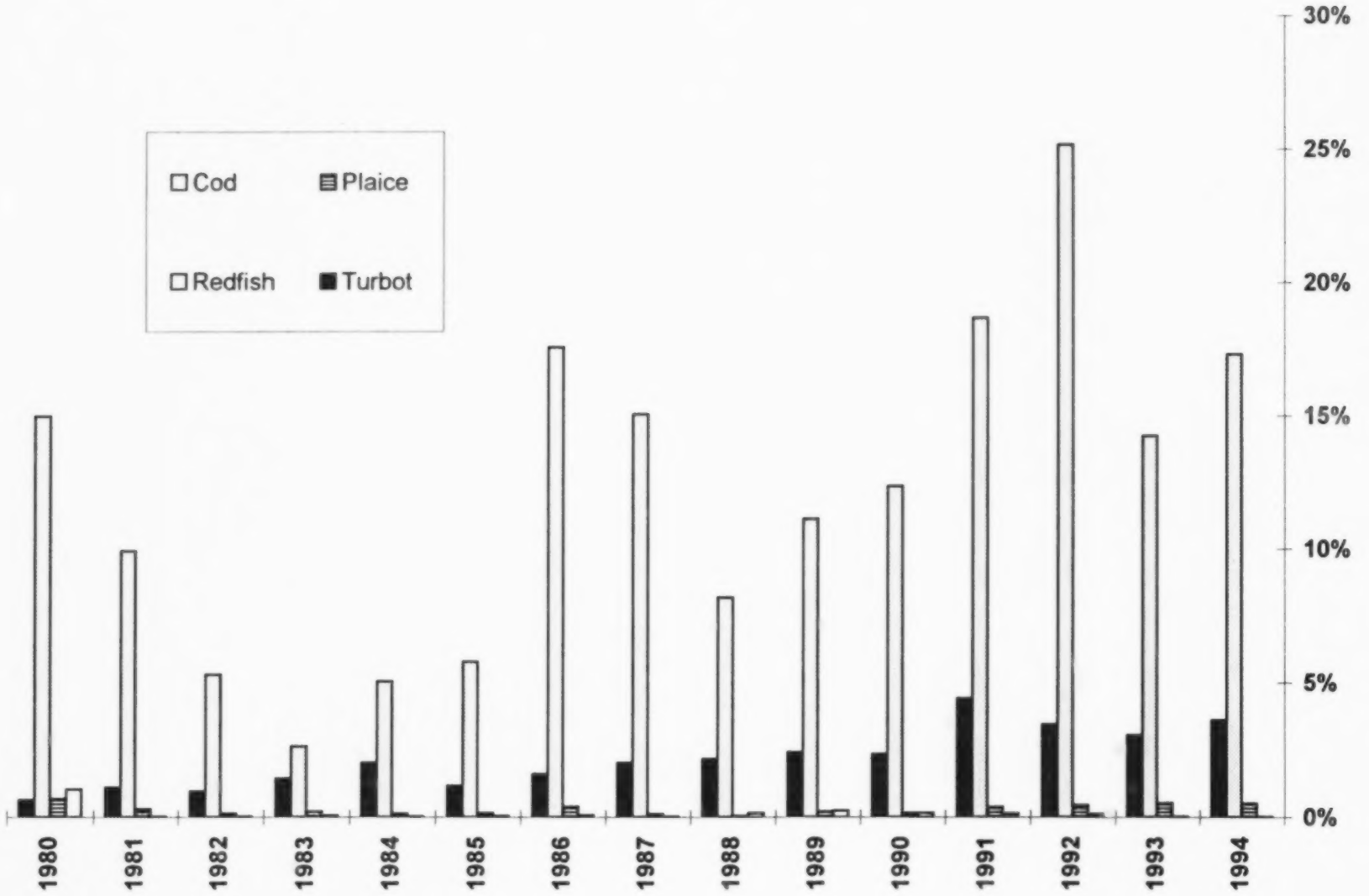

Figure 4 - Groundfish bycatch as percent by weight of shrimp in Davis Strait, Hudson Strait and Ungava Bay shrimp fisheries.

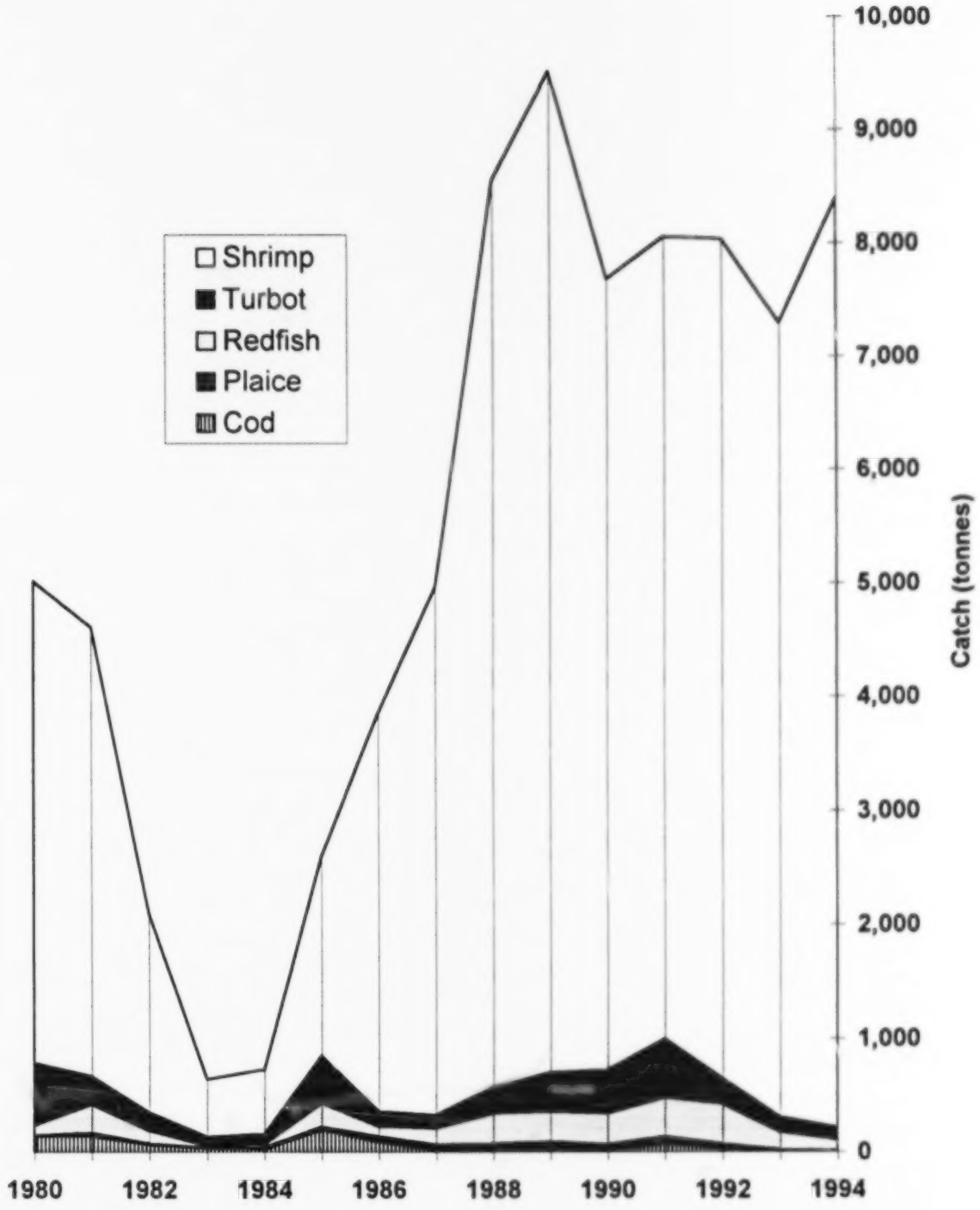

Figure 5 - Catch composition in of shrimp, turbot, redfish, American plaice and cod in the shrimp fisheries in NAFO Divs. 2G and 2H.

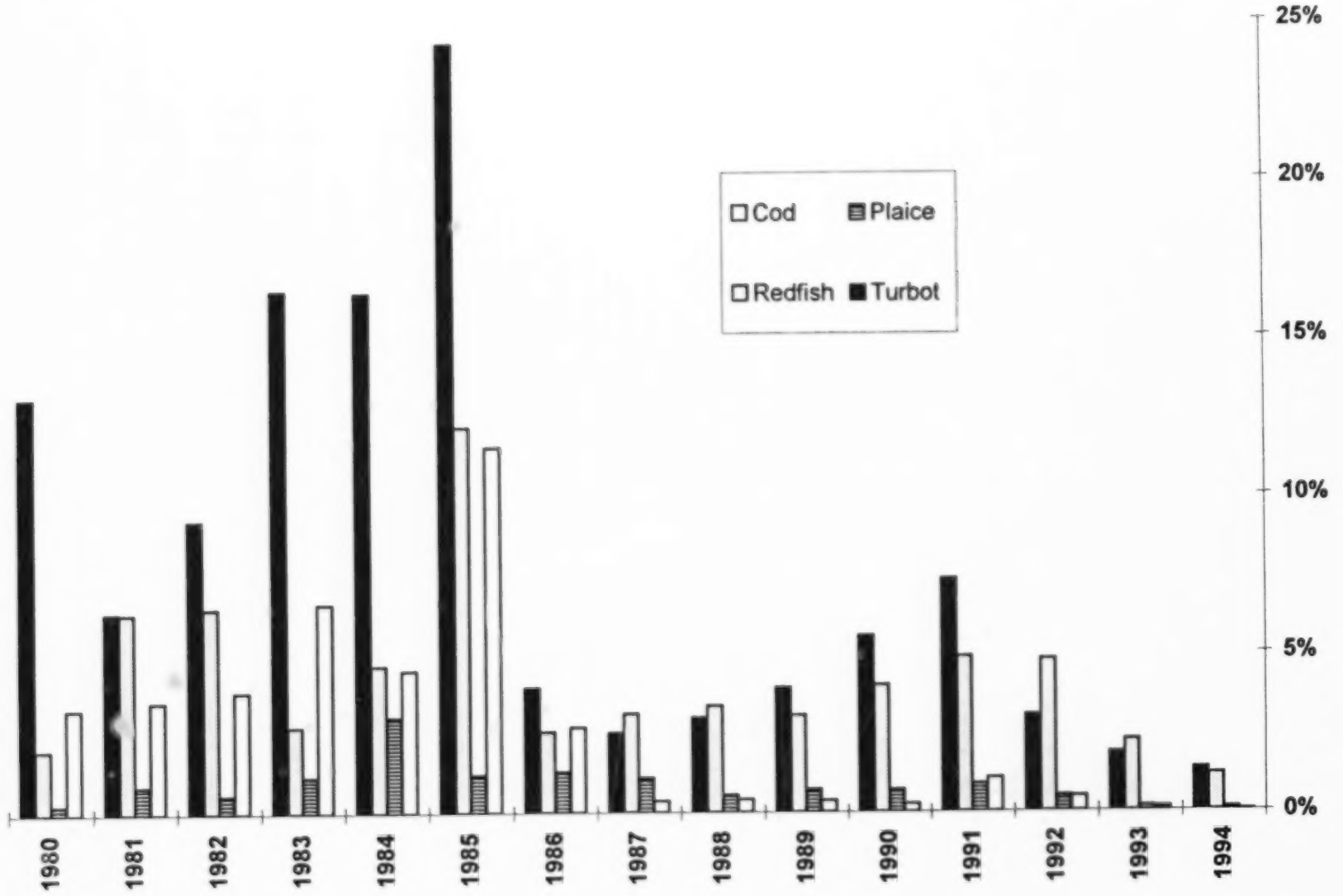

Figure 6 - Groundfish bycatch as a percent of weight of shrimp in the NAFO Divs. 2G and 2H shrimp fisheries.

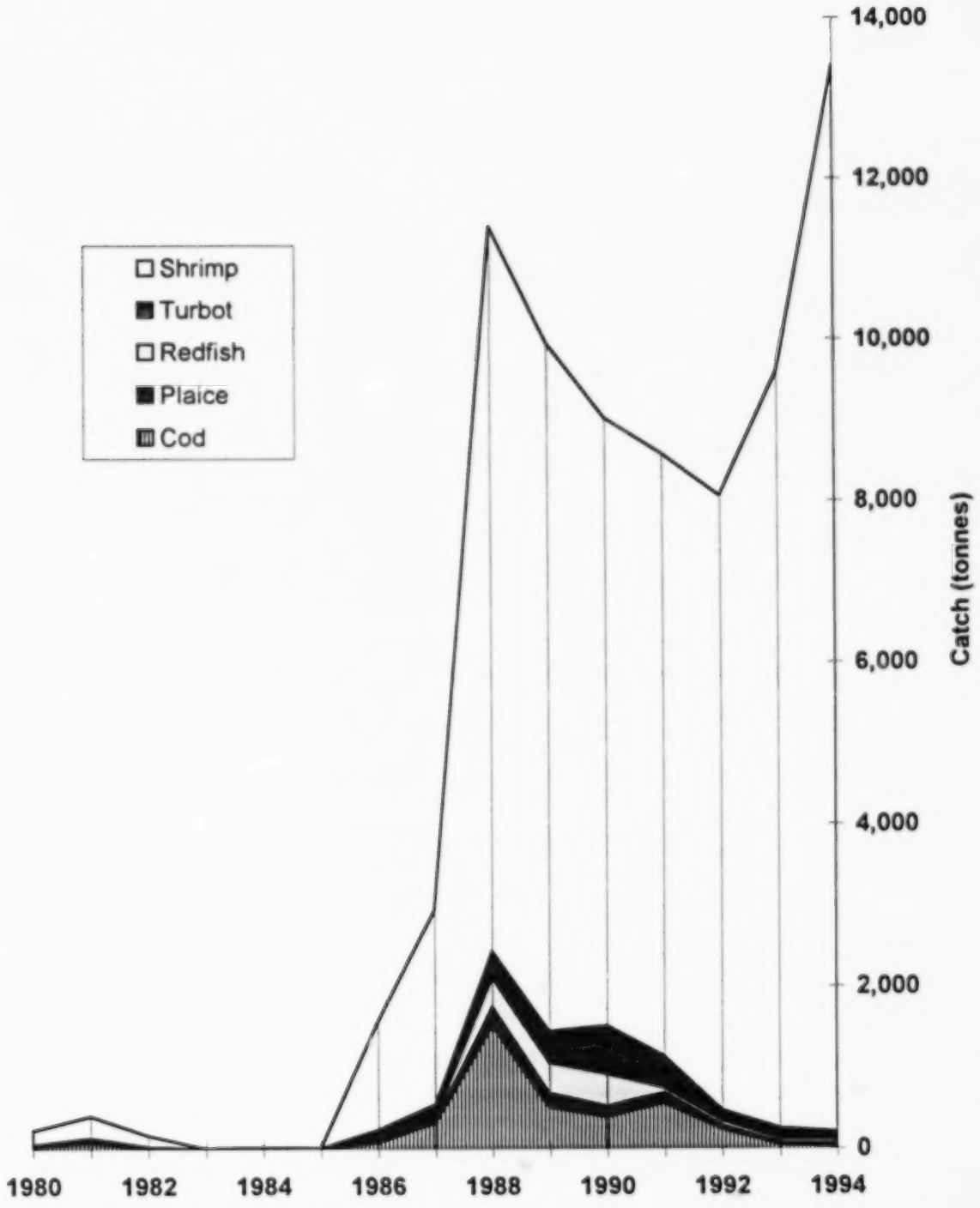

Figure 7 - Catch composition from the shrimp fisheries in NAFO Divs. 2J,3K and 3L. Only the major commercial bycatch species are illustrated.

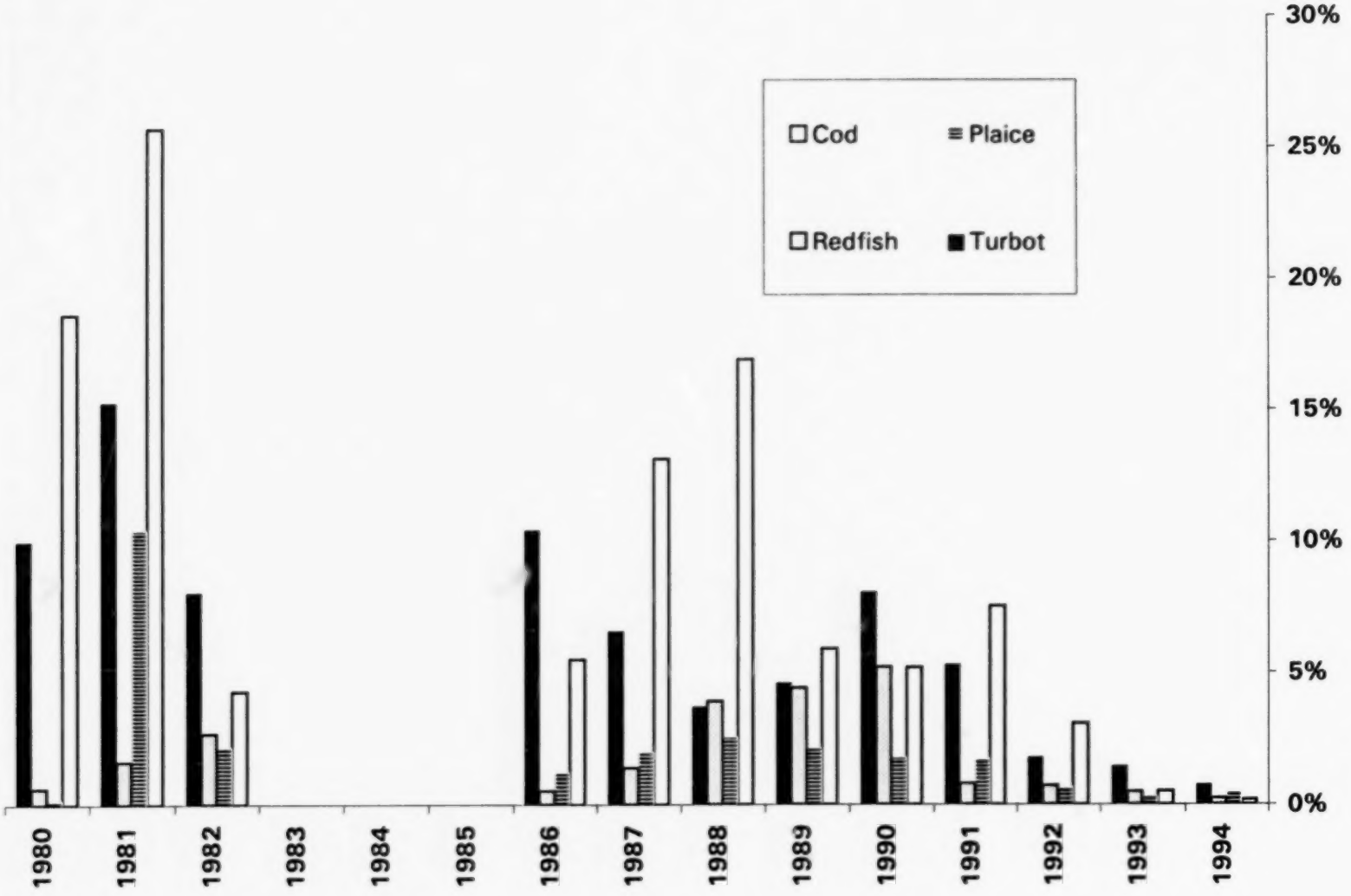

Figure 8 - Groundfish bycatch as a percent by weight of shrimp in the 2J, 3K and 3L NAFO Divs. shrimp fisheries.